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Using project controls to update a university library's automated system

William R. Gholke
San Jose State University

USING PROJECT CONTROLS TO UPDATE A UNIVERSITY LIBRARY'S AUTOMATED SYSTEM

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William R. Gohlke

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APPROVED FOR THE SCHOOL OF LIBRARY AND INFORMATION SCIENCE

Dr. Debra Hansen

Dr. Judith Weedman

Dr. Blanche Woolls

APPROVED FOR THE UNIVERSITY

ABSTRACT

USING PROJECT CONTROLS TO UPDATE A UNIVERSITY LIBRARY'S AUTOMATED SYSTEM

By William R. Gohlke

This project established the planning, scheduling and cost accumulation elements of a project controls system for the installation of a new library automation system at Pepperdine University. It examines the requirements and steps necessary to implement the system and demonstrates its utility in organizing and managing library projects.

Research on this project indicates that adoption of project controls procedures insures that both project personnel and library management understand the goals of the project and how they will be successfully accomplished.

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Introduction

Pepperdine University is an independent, medium-sized university with an approximate enrollment of 7800 students. George Pepperdine, a Christian businessman who started Western Auto Supply Company, founded the university in 1937. The university has campuses located in Long Beach, Westlake, Irvine, Encino, Culver City and Malibu. The Malibu campus is the main campus, and its 830 acres reside in the Santa Monica Mountains overlooking the Pacific Ocean.

There are seven libraries and two administrative library organizations affiliated with the university. Payson Central University Library Organization administers six libraries, located at the satellite campuses and in Malibu. The Jerene Appleby Law School Library Organization administers the law library, also located at the Malibu campus. Currently, there are approximately 909,070 volumes associated with the seven libraries. Of that total, 573,421 volumes are part of the university collection and 335,649 are part of the law library collection (N. Kitchens, personal communication, November 9, 2000).

Recently the university decided to install a new automated library system. The old system was purchased from Virginia Technology Library System (VTLS) in1985, and it now had serious limitations. For one thing, the VTLS system merged the collections of both the Payson Central University Library and the Jerene Appleby Law Library into a single database and failed to differentiate between the two collections. Each library had different procedures and patron requirements that required a separation of holdings. Moreover, the VTLS system did not always provide accuracy and consistency necessary for searches. Indeed, often the system would give different results for the same search query. Finally, and most important, the VTLS system did not have an acquisition module that tracked the effect of new purchases on the libraries' budgets (P. Bohl & K. Kerr, personal communication, February 8, 1999). In short, a new system was required to address and correct these deficiencies. After some discussion and study, Voyager by Endeavor was selected as the new library system. This system exhibited improved search results, allowed the two library collections to be separated into two databases and contained an acquisition module that provided input on acquisitions versus budget.

Introduction and installation of the new system required a special effort by both the vendor and the libraries. Consequently, the university established a project to implement this effort. Payson Central University Library, Jerene Appleby Harnish Law School Library, and Endeavor Information Systems, Incorporated, were the organizations designated as members of this project to accomplish the successful installation of Endeavor's Voyager Library System. These organizations required approximately six months to complete the project.

Installing the new library system required that the university collection database be split into two separate databases, one for the Jerene Appleby Harnish Law Library and another for Payson Central University Library. As mentioned earlier, this was necessary to accommodate differences in collections, procedures and patrons. Each collection was designated a mapping location within the system. These mapping locations partitioned the system into two physical spaces with separate addresses for the two library collections. Once the old VTLS records were successfully migrated into the new

Endeavor system, it was necessary to update the databases with the new acquisitions and serials that had been acquired during system installation. Additionally, budget and expenditures also had to be input to provide current accounting information to the acquisition module. These last inputs completed the databases for both organizations and provided a punch list that the libraries and vendor utilized to check out and debug the system.

The challenge of installing a new library system for both Pepperdine's Payson Central University Library and Jerene Appleby Harnish Law Library was one of communication. Both libraries and the vendor were working independently toward installing the system in an incremental manner. A list of dates, when each of the increments or series of tasks was to be completed, had been furnished to each library by the vendor. However, a formal communication structure specifying the tasks required and the interfaces between these participants did not exist. Without such a structure, which graphically defined the scope and responsibility of each participant, the project ran the risk of the following:

1. Duplication of effort by the participants due to lack of specific responsibilities being assigned.
2. Late accomplishment of tasks caused by inadequate definition of scope and completion date requirements.
3. Confusion regarding the logical order of tasks necessary to complete the migration.

4. Unauthorized changes in scope that would impact participants' tasks without their knowledge or approval.
5. Cost overruns because of inadequate accounting control procedures.

The goal of my project was to establish a "project controls system," which would facilitate communication between the libraries and the vendor and prevent the above from occurring. Project controls are defined "as the process of making events conform to plans" (Clough & Sears, 1979, p. 8). The system utilizes the elements of planning, scheduling and cost accumulation to formalize communication between project participants.

Planning the project identifies who the individual participants are, what their project responsibilities are and how their responsibilities relate to the work of other project personnel. Establishing these parameters eliminates duplication of effort, defines individual responsibility and logically structures the project. Logically structuring a project simply means establishing the logical steps of work necessary to complete the project scope.

Scheduling the project introduces time constraints to the plan. The responsibilities or activities of each project member are assigned time durations. Assignment of these durations communicates to project personnel when they are required to perform their project activities and for how long. This insures that the project has a beginning and an end.

Cost accumulation provides the participants and their management insight into the costs of the project as it progresses. These project costs are not confined to the purchase of the new library system. They also include the costs of the library staff as they participate in the installation of the system. Management requires such data to properly evaluate the new system and better understand what future systems may cost.

My project established the planning, scheduling and cost accumulation elements of the project control system for Pepperdine's library automation project. Within the planning element, I identified key project participants and logically structured the project's activities. Within the scheduling element, key project personnel and I established the necessary time durations for all of the project activities. This provided the project with an overall project duration, as well as the starting and finishing requirements for each project activity. Although the university did not require the cost accumulation element, I provided them with a general estimate of costs over the duration of the project based on actual plan/schedule input.

The significance of my project is twofold. First, it demonstrated to the university the utility of project controls in installing a new library system. As a result, the university had the necessary organization to successfully complete their project in a timely and efficient manner. Secondly, my project also has value to the library and information science community by demonstrating how project controls can be used to manage library projects. With more and more libraries being required to automate systems, create web sites and undergo remodeling within specific time and budget constraints, this project offers a practical model of how to effectively manage such efforts. It provides specific guidelines for how to define the project's scope completely, so that the finished product fulfills the expectations of its sponsors. This project also illustrates how project controls tools, such as Critical Path Methods, provide early warnings to problems that arise as the library project progresses. Practical lessons learned on this project can be applied to successfully manage other projects.

Literature Review

The following articles and books contain an applicable body of knowledge that assisted in developing the methodology for this project. An investigation of the literature in this area revealed an interesting phenomenon, the existence of a large body of literature in engineering and construction but a very small body of literature in library and information science. The reason for this disparity appears to lie in the scale of projects in the two fields. A number of these references on project controls for engineering and construction projects were written in the late seventies and early eighties. During this period, the defense and oil industries were involved with large multimillion-dollar projects, which required the development of project controls procedures. These procedures were established to insure budgetary control and timely completion. Projects and programs like the Alaska Pipeline, Saudi Arabian Gas Recovery and Stealth Aircraft Technology served as a proving ground for developing and testing these procedures. The result, for the engineering and construction disciplines, is a rich resource of reference material available for managing petrochemical projects and defense programs. The library community, on the other hand, has not experienced large multi-million dollar projects similar to those found in the construction and defense industries. Consequently, they have not had the resources and impetus for analyzing their operations and developing project control procedures. The result is a limited body of reference material.

There are several outstanding books that deal with project management and project controls as they apply to engineering and construction. Construction Project Management (Clough & Sears, 1979) and Project Management (Lock, 1977) are excellent examples.

Richard Clough and Glen A. Sears's (1979) Construction Project Management has often been used as a text at the UCLA Extension Certificate Program in Engineering for Construction Management. This program is jointly sponsored by UCLA Extension and the Associated General Contractors Association and was created to educate prospective employees in project management techniques for the construction industry.

This text provides examples and explanations of the project controls tool "Critical Path Methods." Critical Path Methods or CPM is the basis of the information reporting system that management utilizes to control the project. Development of a CPM requires that the coordinator or planner/scheduler visit the various key project members to determine the tasks required to complete the project and then assemble the project plan. This plan is graphically illustrated in a logic diagram format that reflects the various work activities and their interrelationships. The logic diagram is then known as a CPM network. Durations of time are estimated for each activity; this converts the plan into a schedule that defines when each activity must start and finish. A forward and backward pass calculation is performed on the network, which reveals the early and late dates for each activity. The difference between the early and late dates is known as "float."

Float is the amount of time that an activity's start or finish can be delayed until it becomes critical and affects the overall project duration. Activities that have zero float are considered critical because they cannot be delayed without affecting the overall project duration. These interrelated critical activities form a path from the start of the project to its completion. This path is known as the project's "critical path" and establishes the overall duration of the project. The calculations that determine float and the project's critical path can be performed manually for smaller networks or by computer program for larger ones. The authors introduce these calculations with simple civil construction examples that assist in understanding how a critical path is developed and the economic advantages of utilizing float for non-critical activities. Simply put, it is often more economical to delay a non-critical activity until existing resources are available than to incur the expense of hiring additional resources for only a short period of time. Additionally, understanding how the calculations work, as well as the importance of them, is helpful when debugging large computerized networks.

Dennis Lock's (1977) <u>Project Management</u> not only addresses the above techniques but also the characteristics of a project manager. The project manager's position is usually temporary. This is due to the fact that projects are normally temporary, unless the organization is devoted to project management. Their leadership is drawn from the organization and returns to its original duties when the project is complete. Lock indicates that this situation creates unique challenges for the manager. Managers must possess a broad area of expertise to effectively direct diverse groups on their project. Their organization must provide them the power to solicit cooperation from other managers associated with the project. They cannot be gullible. Instead they must understand and use the tools of project management to maintain the integrity of the project. Finally, they must possess a dynamic personality that will sustain the project through its many challenges to completion (Lock, 1977).

Both Jelen's Cost & Optimization Engineering (Humphreys, 1991) and Applied Cost Engineering (Clark & Lorenzoni, 1985) deal with controlling project costs. The American Association of Cost Engineers recommends reading Humphreys's (1991) text when preparing for their annual Certified Cost Engineer examination. This text deals with the principles of cost, optimization engineering and engineering economy. Several authors contribute to this comprehensive work, which is devoted to understanding and solving cost problems. Along with insight on how to calculate depreciation, linear programming and compound interest this text discusses the requirement for cost data. It indicates that as products or services are created there is a requirement for detailed cost data. This data provides the basis for decisions by management that will ultimately decide the profitability of the enterprise. Such data must be of the highest quality to insure that the measuring of economic events in monetary terms is accurate and trustworthy (Humphreys, 1991).

Clark and Lorenzoni (1985) focus on refinery project cost control techniques. Refinery projects are highly complex due to the number of engineering and construction disciplines involved. This complexity has required stronger communication between the larger groups of participants to insure budgetary compliance. Consequently, the emphasis on communication in this text makes it especially valuable for projects that will require cost communicating skills.

Projects evolve because there are increased demands for existing products, market research predicts new products that have high sales potential or government or social organizations reveal the need for new facilities. Whatever the project, economics is the chief criterion used to determine its existence. A basic question is what is the maximum return that can be made from the money invested (Clark & Lorenzoni, 1985)? According to Clark and Lorenzoni (1985) the cost engineer is responsible for answering that question.

Clark and Lorenzoni also provide information about determining a cost estimate prior to the project, updating the estimate during the project to reflect inflation and scope changes, and a final cost estimate at the conclusion of the project. This final estimate is often referred to as the "as-built" estimate. The cost engineer assembles each of these updates to the estimate and uses various mathematical forecasting methods to utilize historical project cost information trends to produce forecasts of future final costs. For example, labor costs are forecasted from labor cost data accumulated by the cost engineer as the project evolves. A productivity factor is calculated by dividing the number of hours budgeted to accomplish the work by the hours actually required. Dividing the number one by the productivity factor (1/productivity factor) provides an efficiency multiplier. The efficiency multiplier indicates how efficiently the job is being performed. Multiplying this multiplier against remaining budgeted hours produces a forecast that reflects what the expected actual remaining hours will be based on previous work accomplished (Clark & Lorenzoni, 1985, p. 241).

Finally, the Clark and Lorenzoni text explains how the cost engineer, by performing the above estimating functions, provides the customer not only timely project cost information for return on investment calculations, but also furnishes data necessary to judge the project management's performance. If a trend develops where labor productivity is continuously under performing its estimate, questions must be asked about the accuracy of the estimate as well as the performance of the project manager.

As we can observe, Clark and Lorenzoni's (1985) techniques recognize and emphasize that cost data must be continuously communicated to both client and project management to allow both parties the opportunity to control project costs. Their techniques emphasize data that is current and accurate so that only the best decisions are made.

Preventing and Solving Construction Contract Disputes (Hohns, 1979) recognizes that even the best project controls system is limited by the personalities of the management responsible for the project. Strong personalities are necessary to make things happen on projects. Often the personalities of contractor and client are such that conflict is inevitable. Whatever the reason, conflict is a part of project life, and often a necessary one. Hohns's text recognizes this phenomenon and provides guidance on managing conflict.

Although there can be many different issues that can create conflict on a project, Hohns indicates that time is the principle issue that results in lawsuits. The reason for this is that any extension of a project's duration results in additional cost. For example, the contractor will experience additional cost, because an extension of project duration may require the contractor's staff and equipment to remain at the job site longer than anticipated to complete the job. The owner experiences additional costs because the completed project is unable to generate the revenue or services that it was constructed for (Hohns, 1979, p. 55).

Hohns indicates that the use of a CPM network for planning and scheduling a project provides all parties an opportunity to participate in the planning process. As the project advances, the actual CPM plan/schedule is updated to correct errors, include better ideas and assess the progress of the project at predefined intervals. CPM establishes a continuing dialog between project participants that seeks to resolve project time conflict issues before they devolve into litigation (Hohns, 1979, p. 80).

If conflicts do result in litigation, Hohns (1979) advocates using the final as-built CPM to demonstrate the cause and effect of delays on the original project plan/schedule. This document provides a compelling graphical illustration of the project's history. It depicts the evolution of the project from its beginning to its conclusion and reflects how changes and performance have affected the original plan/schedule.

Finally, Hohns (1979) recognizes that CPM formats are criticized and that some feel that they do not work. However, his experience indicates that CPM does work and that it is the people in charge of the job that do not work. Such people do not wish to be constrained by a plan or have their performance measured. They are the real problem on a project, not the CPM schedule.

These texts provide essential philosophy and instruction in the use of project control tools. Although these texts utilize project examples that are engineering and construction oriented, their applicability is universal.

Professional literature on project management in libraries is more limited than in the engineering and construction disciplines. In Systems Analysis for Librarians and Information Professionals (Osborne & Nakamura, 1994), the authors indicate that their book was written because they could not find a text that was not too technical, business oriented or philosophical to be used as textbook for information system courses. This text provides an excellent chapter on "Project Management and Control." Like most texts, it explains that Critical Path Methods are used to define the longest path of a project, which will determine its overall duration. Any activity impacted on that path can lengthen the overall project.

An interesting and unique feature of the Osborne and Nakamura text is the discussion of the triple constraints of a project. The triple constraints are performance specifications, time, and budget (Osborne & Nakamura, 1994). Both time and budget have been discussed in detail in the review of engineering and construction reference texts. Performance specifications have only been alluded to. A performance specification is the expectation of improvement that management believes the completed project will bring to the organization. Osborne and Nakamura explain that projects evolve because there is a requirement for them by their sponsoring organizations. This is an elementary premise. Yet, when the project is complete, has the requirement been satisfied? Libraries, when automating, may believe the project is successful when the last terminal is hooked up. However, if the library has not thoroughly thought out what its requirements are, and compared them with the project as it evolved, it may be unpleasantly surprised at the final results.

According to Osborne and Nakamura, it is also imperative that libraries formalize their projects by creating a "statement of work" (Osborne & Nakamura, 1994, p. 162). This statement or scope includes a description of the work to be accomplished, an outlined statement of an implementation plan and a statement addressing the project's triple constraints. Once this document is written library management should approve it. Its existence provides both project and library management the basis for deciding whether the project has been successful.

Elaine Sanchez (1996) in "Project Management and Organizational Change from the Advent to the Aftermath of Automation: Library and Cataloging Department Perspectives," provides a project example similar in nature to the one at Pepperdine University. Like Pepperdine, this project is the automation of an existing academic library (Southwest Texas State University) collection. It provides the reader insight and background regarding the typical statement of work that libraries confront when installing a new library system. Although every project is different due to history, collection, resources and staff, a "feeling" for previous projects often can assist current ones.

Albert Altek Library, of Southwest Texas State University, began their project by first participating in a project feasibility study. Sanchez (1996) indicates that this study established the need for the project, the goals of the system, cost, staff and hardware/software requirements, and provided the project its initial performance requirements. With performance requirements established, the library was faced with either seeking a local programming solution or utilizing a vendor automated software package. The feasibility study provided them sufficient criteria to make their decision for the vendor automated software package.

Once the contract was signed, it was necessary for the project coordinators to prepare the database and conversion tables. This required that the old system be reviewed for information that needed to be transferred to the new automated database. The automated system vendor then established conversion tables that converted information such as MARC bibliographic text records to item record locations and circulation values. Establishing the information parameters for the system required that the staff really understand how the system worked before making their decisions. Sanchez instituted quiz questions to aid comprehension and participation.

Once the database criteria had been established smart barcodes were attached to the physical collection. Members of the collection staff who were experts in the various areas of the collection performed this task with the catalogers. Action items were determined and status meetings were held weekly to maintain momentum on the project.

The project culminated with solving any barcode problems that were unique to the system and updating the database with new acquisitions. As the project progressed toward completion, Sanchez noted that more of the staff became active participants. They became "owners of the new system (Sanchez, 1996, p. 100)."

The fact that they had an input into the formulation of the system insured its success. As they observed the project complete its planned activities, their pride provided it with momentum to finish. Although this project did not use sophisticated project controls and has some specific differences from Pepperdine's automation project, it is an excellent example of how organized participation can make a project successful.

Additionally, Sanchez recognizes a very important characteristic about projects. Projects are temporary events with set objectives that must be accomplished in specified periods of time. Her library required a new automated library system and the installation of that system required the assistance of library staff members. The project thus required the staff to work additional hours or reduce work in their own areas to accomplish the effort. Either way, expenditure of these resources needed to be controlled or the operations of the library and its budget could be imperiled by the project. Consequently, both management and staff needed to recognize their vulnerability and work quickly to complete their projects.

"Administration and Management: Library Automation Systems Project" (Cheney, 1993) also addresses project controls for automated projects in academic libraries. The techniques advocated in this text include: analysis of projects for priority in the organization, establishing resources within the organization, and managing their ultimate completion. The author utilized dBASE IV software rather than project management software. Although dBASE IV is an outstanding software package, if the author had had a better understanding of CPM, he would have realized the advantages of project management software. Such software contains algorithms that allow construction of project interrelated activity networks. Once these networks are constructed, the algorithms perform forward and backward pass calculations, which indicate the path of work activities and their relationships that establish the project duration. This path is known as the critical path, because, as explained previously, any extension or contraction of these activities will affect the project duration and its associated costs. Understanding which project activities control overall duration and cost allows management to concentrate its efforts where they have the most impact.

However, this article does provide excellent insight into organizing staff for participating in various automation projects that are assigned to a library. Engineering and construction contractors are hired specifically for projects. Libraries, in contrast, have operations that are principally of the recurring type (collection management, cataloging, etc.) and new projects involve additional work. Cheney formally addresses this issue with a "positive approach" that resources are going to be required in the future to repair, augment and enhance the system. Management must recognize this and secure the resources necessary to guarantee the automated system's continuing success.

To identify what additional resources are needed, Cheney suggests that the time required for the recurring effort of each staff member be analyzed and estimated. Then the amount of time required for project effort was calculated to build a realistic schedule. Additionally, a 20% slack was built into this resource schedule to provide for "unscheduled" activities (Cheny, 1993, p. 10). Reviewing this schedule with staff members provided them a sense of commitment, because they had contributed toward organizing themselves to participate in future projects.

"CPM and PERT in Library Management" (Main, 1989) explains the differences between PERT (Program Evaluation Review Techniques) and CPM and discusses project management techniques. PERT was originally developed by Lockheed to manage missile development programs. In these programs it was difficult to estimate how long it would take to produce a product. Unlike construction projects where activity durations are determined by work that has been performed on other projects many times over, missile programs could not draw upon past experience to estimate activity durations. Therefore, PERT allowed each activity to have three estimates: minimum time, a modal time and a maximum time (Clough, 1972, p.85). PERT then applied probability factors for each time estimate to provide the optimum duration. The engineering community due to all the estimating that was required considered this technique cumbersome. CPM, with only one estimate per duration, has supplanted PERT as the preferred tool of project management.

Main identifies one of the major advantages of PERT/CPM networks: that although the mass of information available from PERT/CPM networks can cause overload, the system is organized to overcome this problem. This is accomplished by "managing by exception." This means that management only concerns itself with project activities that reside on the Critical Path, or are about to become a part of it due to performance problems. Periodically updating the project with status on project activities allows management to maintain a current picture of what those activities are, and manage them as exceptions to other activities that are performing as required. Management thus optimizes its own resources in the most efficient manner to control the project.

Main (1989) concludes that the CPM/PERT provides a defining structure, which all projects require. This structure adds clarity to what must be done, by whom and when.

This system is not a "quick fix" for managing a project. On the contrary, a rigorous understanding of project scope is the result of this system. Thoroughly understanding the project scope provides management insight for providing timely resources necessary to complete a project on time, and within budget.

In summary, the literature review discusses the basic tools necessary to manage a project. It recognizes that people are the major cost contributors to a project and that they are also a source of conflict and cooperation. The basic challenge for project managers is to harness the various emotions of people to the goal of completing a project in a set period of time within budget constraints. Project management tools assist them in this endeavor by soliciting their opinions and providing feedback on their performance.

Engineering and construction projects over the past 30 years have developed and refined these project management techniques because of the industrial development that has occurred in such industries as defense and energy. Currently, the information industry is experiencing similar growth. This situation has required libraries to become involved with projects that will increase their readiness to service future demand. My project introduces to library professionals a library automation project that successfully utilized these project management techniques. The results of this effort provide insight for other librarians interested in this methodology. Additionally, this project may serve as guide for use with future projects or as a comparison for current efforts.

Methodology

My role in the installation of the new automation system at Pepperdine University was to serve as a consultant to the project managers. My responsibilities included assisting managers in the use of project controls methodology to establish project milestones, a CPM plan/schedule, assessing of discrepancies between anticipated and actual performance and providing suggestions for managing such discrepancies.

The first step in adopting project controls methodology in an automation project is to identify key personnel from the libraries involved and the vendor. According to Sanchez, "these are the people who will take the lead to set out the management methods and project goals that can best work with local resources and our acceptable to the administration (1996, p. 98)." It is important that these individuals include staff from both the libraries and the vendor, to ensure that all interests in the project are represented and to provide a formal communication conduit between the participants.

Once the appropriate personnel are identified, the second step is to present these personnel with the key ideas and procedures of the methodology, focusing on the costs and benefits of its adoption. Cheney's article indicates that this presentation is critical. If staff leaves the presentation with the impression that the methodology is just another "bean counting" exercise, the chance of it being accepted is minimal (1993, p. 10). However, a presentation that illustrates how project controls reduce confusion and uncertainty on a project is a strong selling point for acceptance by project participants. It is important that the consultant's presentation and the organization's adoption of the project controls methodology be accomplished at the outset of the automation project. This ensures that coordination between participants occurs during the entire length of the project.

Once the participants adopt the project controls tools, they become members of an advisory committee for the project. The consultant works with this committee to identify the critical activities that affect the duration of the automation project, define the logical workflow, calculate resource requirements, and establish project milestones. These items are incorporated into a Critical Path Method plan/schedule; this document is dynamic in nature, evolving in response to factors influencing the project's course.

According to Clough and Sears (1979) project activities seldom start or finish as scheduled. Consequently, the consultant must call periodic meetings to assess their progress. Updating the status or progress of project activities will indicate whether the overall duration of the project is still the original planned one, or if events have prolonged the project. Additionally, the consultant holds committee meetings to discuss changes that arise in the course of the project, resolve conflicts, share solutions, and ensure that project commitments are met.

The consultant is also responsible for selecting project management software and providing the graphics that track the progress of the project. These graphics display the complete plan/schedule, current status of project activities, and responsibilities of the participants. Graphics also identify the project's critical path and define the float values for each activity. With such information project participants have a visual and ready reference of project responsibilities and their status.

At the conclusion of the project, the consultant "closes out" the project by performing the following steps. An as-built schedule is created which documents the project's critical events and actual timing. This document provides useful historical data for planning and scheduling future projects. Once the as-built schedule is complete an as-built resource distribution histogram is created. The histogram furnishes approximate resource staffing requirements over the duration of the project. Both of these documents, along with project correspondence, complete the final picture of how the project was managed.

These steps, from planning through implementation and final reporting, create information that is usable as the automation project unfolds, allowing decisions to be made as conditions change, and leaving a record for use in future planning.

Implementation

This project focuses on providing project controls services to the library management of Pepperdine University to be used in supporting the installation of a new automated library system. The new system was procured from Endeavor, Inc., and is known as "Voyager." Payson Central University Library, Jerene Appleby Harnish Law School Library, and Endeavor, Inc., were the three organizations involved with this project.

The first step necessary to implement project controls at Pepperdine University was to identify the key personnel that would be associated with the project. According to Sanchez (1996), these people provide the leadership necessary to mobilize support from management and staff. I was able to identify Dr. Daniel Martin, the Director of the Jerene Appleby Harnish Law School Library, and Nancy Kitchen, the Director of Payson Central University Library, as the leaders responsible for the new library system. They, in turn, identified members of their staff who were working on the project. Phillip Bohl and

Catherine Kerr were from the law school library, and Christopher Thomas and Christopher Koble were from Payson.

The next step was to acquaint the participating personnel with the key ideas associated with project controls. Consequently, I arranged a meeting that would allow me to introduce both myself and project controls. As Cheney indicates in "Administration and Management: Library Automation Systems Project" (1993) such meetings are critical for recruiting support for this methodology. For one thing, they allow the project controls manager to demonstrate to management and staff the advantages of project controls and the benefits of using the system. Projects without project controls can be confusing to the participants because they lack organization. My presentation focused on how the system reduced confusion and uncertainty on a project. In addition, project personnel are often saddled with unrealistic expectations from their management. Such expectations result in unnecessary conflict that reduces effective communication between participants. Thus, my presentation showed how project controls establishes realistic management expectations by using input from key project staff to plan the project.

In short, I wanted both management and staff to recognize the organizational benefits of project controls. As stated earlier, the system was not a bean counting exercise. It possessed benefits for everyone. Project responsibilities of staff would be clearly defined. Management would know what to expect and when. Everyone's performance would be visible for scrutiny.

The meeting lasted approximately an hour and a half. It was attended not only by the key personnel but also by the staff of the law school library. During the meeting, I presented and explained the tools used in project controls. I explained what a project's critical path was and how project float was calculated. Several slides of the Alaska Pipeline were presented that demonstrated the problems encountered in the hostile arctic environment of the North Slope of Alaska. Using these slides I explained how planning and scheduling the activities in advance not only sequenced the work but also provided input on when and how many of the various tradecrafts would be required. This assisted management in planning the size of their construction camp and in adjusting their mixture of crafts (i.e., laborers, pipe fitters, electricians etc.) to the type of work being performed.

After the meeting, informal discussions continued with Nancy Kitchen and Dr. Daniel W. Martin. Both directors recognized the natural competitive tensions that existed between their libraries. Kitchen favored a tool that would promote open communication and coordination between the libraries. As her library would be the first recipient of the new system, she felt that any lessons learned during the transition at Payson could profitably be passed on to the law library. Consequently, she recognized the communication benefits of project controls and endorsed Payson participation.

Dr. Martin indicated his concern that the law school library required a formal communication channel with Endeavor, the system contractor. Dr. Martin felt that the inclusion of Endeavor in the project control process would not only insure a complete picture of the project, but also insure establishment of a necessary communication channel. He also felt that a historical record of the steps and time necessary to install the system would be a helpful tool when considering future system updates.

Both directors endorsed using planning and scheduling to organize the project, report on its status and foster communication between the participants. As the university had already budgeted funds for this project they did not feel the necessity to track costs. However, a general estimate of resources required and their distribution over the project duration would be helpful. With these parameters agreed to, I commenced.

My first effort was to insure that we had all of the key members available to plan and schedule the project. These personnel would become part of a permanent project management committee. As Endeavor was going to play a key role in the project, and Dr. Martin had emphasized their importance, I wanted them represented in our efforts. Nancy Kitchen volunteered to secure Endeavor's cooperation. She contacted Endeavor and solicited the cooperation of Karen Gegner, the project engineer for Endeavor.

Although Endeavor agreed to assist in the planning of the project they were not legally bound to participate in the effort. The contract that they had signed did not include provisions regarding utilization of project controls procedures. Nevertheless, Gegner agreed to participate in the effort. As she was located in Chicago, Illinois, it was necessary to communicate with her by e-mail and telephone. This inconvenience did not adversely affect communication among the participants.

The fact that a project controls provision was not included in the contract was a potential disadvantage for Pepperdine. Without the legal obligation by Endeavor to participate in the project controls process, Pepperdine lost an important tool that could have been used to guarantee timely completion of the project. However, as Hohns indicates, if a scheduling system is being used on a project it behooves the general contractor to exhibit and share that scheduling information for the good of all participants. Good quality information sensibly displayed insures that all participants are aware of the project's time constraints. This is often enough to prevent litigation over time commitments (1979, p. 49).

Timing is an important element when administering a project. If a project has commenced without instituting a project control system, it can be difficult to recapture the momentum, time and cost that may be lost due to lack of organization. Once these important elements have been spent, there is no possibility of recovering them. Introduction of project controls is not an automatic occurrence. It requires time to develop and implement a system. While that time is being used to introduce structure to the project, irrecoverable resources continue to be expended in less than optimal fashion. Consequently, commencement of the project controls effort prior to project kick-off insures an orderly transition of dedicated project resources for accomplishing planned activities.

Since the contract between Endeavor and Pepperdine had only recently been signed, it was important to begin work immediately. Clough and Sears indicate that constructing a CPM network requires three phases. The first phase requires planning what has to be done, how it will be accomplished and in what sequence. This is the most difficult phase and the most important because it requires the participants to become intimately knowledgeable of the project's scope. The second phase requires estimating and adding time to the planned activities. The result is a plan/schedule. Finally, the third and final phase monitors the project's plan/schedule activities progress to insure compliance by the participants (Clough & Sears, 1979). This was the basic approach I used to construct the project's CPM plan/schedule.

Phase 1: Planning and Scheduling

During phase 1, Gegner of Endeavor furnished the management committee with a list of dates that defined when she would be commencing and finishing her system-related activities. These dates are known as "milestones" and are important project events (Clough & Sears, 1979, p. 122). Both Payson and the law school library assumed responsibility for supporting the timely completion of these milestones. This process placed Endeavor as the prime mover in the project, and without a doubt their effort affected a great deal of the project. However, it was also important for the libraries to understand that they needed to examine their own "activities" as well. Clough defines an activity as a single work step with a recognizable beginning and ending that requires time for accomplishment (1972, p. 59). Each library had to be cognizant of their own activities as well as of those supporting the milestones of Endeavor. They also needed to examine how these activities interfaced with each other.

I experienced a similar situation on a government project that was located in Louisiana and Texas. This project was responsible for constructing salt dome storage facilities for the Strategic Petroleum Reserve. The headquarters for the project was located in New Orleans, and I was requested to fly there and replace one of our company's project controls personnel who had been dismissed. Naturally, it was a stressful situation and I was curious to learn what had occurred. Luckily, I met the employee before he departed the project. We talked, and he showed me the plan/schedules he had created for each subcontractor at the site. There were individual plan/schedules for the civil, structural, piping, instrumentation and electrical work to be performed. The logic and planning for each subcontractor was flawless. Unfortunately, he had not integrated these separate schedules to reflect the necessary constraints that occur between these subcontractor crafts. Consequently, when the first day of the project arrived, all of the subcontractor crafts arrived (approximately 150 people) at the site to commence working. Naturally, the subcontractors also brought along their very expensive equipment. As the site only required 20 people from the civil subcontractor to begin clearing and grading the work area, the additional 130 people were unnecessary. They should have been introduced into the site as space and materials became available to them later in the project cycle. Because the individual plan/schedules of the subcontractors had never been integrated, there was no overall project plan/schedule that reflected the physical constraints between subcontractors. The result of this episode was a substantial claim for lost time being submitted to the project by all of the affected parties. Even more important, for the remainder of the project the control effort was under a constant cloud of perceived incompetence. The lesson I learned from my unfortunate colleague was to confirm that overall project plan/schedules always reflected the relationships and constraints that existed between all participants.

As Payson Central Library was the first library scheduled to convert to the new automated system, detailed planning/scheduling meetings were arranged to establish what work and resources were required. Kitchen, Koble and Thomas attended these meetings. Review of the milestones furnished by Gegner revealed that Endeavor needed to complete three milestone events to install the new system in both libraries, for a total of six milestones for the total project. These milestones are shown in Appendix B. They are the completion and acceptance of the test loads, patron loads and production loads for each library. The test load milestone involved separating the law school and Payson databases from VTLS into two distinct databases. Once this was successfully accomplished the patron load milestone defined the specifications for the patrons (students and faculty) of each database. Finally, the production load milestone would test the functionality of the system and its associated modules (circulation, OPAC, serials, and acquisitions).

My immediate goal was to establish what activities were necessary for Payson to support their three milestones. Kitchen, Koble and Thomas indicated that the Payson test load milestone (Milestone #1) required Payson staff to verify separation, location and retrieval of the online catalog data load. The data load consisted of the records associated with each catalog item. Staff feedback would enable Endeavor to correct any identifiable problems. A rough logic (Appendix A) was constructed that indicated the staff's activities, their relationships and time requirements necessary to support the test load milestone. Approximately four librarians were assigned to this stage of the conversion project.

The next milestone (Milestone #2) was the establishment of the Payson patron load. Specifically, Payson's patrons were the faculty and students. They each had their own record requirements, and their data needed to be successfully transferred from the old system to the new one. Payson indicated they needed a data extraction program to assemble their patron load. Once they had the load they would test and verify its accuracy. This group of related activities and their durations were added in Appendix B. Approximately two librarians were assigned to this effort.

The Payson production load was the third milestone. This particular milestone required Payson staff to test the various modules (circulation, security, OPAC, work stations, etc.) for functionality and establish the system administration configuration (C. Thomas, personal communication, September 5, 2000). Approximately four librarians would be required for this effort, and I added the logic and durations to the existing drawing.

At this point it appeared we had accounted for all of the work that Payson was required to perform to bring the new system online. This process can be a tedious affair and people who are busy with other enterprises often become impatient when being questioned continuously. Yet my experience led me to believe that we did not have the complete scope of the project. The logic still only addressed activities that supported Endeavor's efforts and did not reflect any interfacing relationships with the law school library. Additionally, I felt that Payson's efforts did not terminate with a milestone that would signal closure for their portion of the project.

Further discussions revealed that Payson had been able to accumulate funds for the purchase of new computers. These computers would be for both the staff and general student body. They also would be dedicated specifically for use with the new library system. Their procurement, delivery, installation and configuration would impact operation of the new system at Payson. This additional scope was added to the plan/schedule for Payson. At this point, Payson still lacked a milestone that defined the objective of when they were required to complete the project. However, it was important to move on to the law school library.

As mentioned earlier, there existed a certain amount of healthy rivalry between the two libraries. I decided that the next round of meetings for developing the law school library logic should also include members of the Payson committee. This would provide the law school library the opportunity to validate their perceptions of what needed to be done against the experiences of Payson. Also, I hoped that a certain amount of conflict might arise from their natural rivalry that would reveal the interrelationships between them.

I have often used this technique when constructing engineering and construction plan/schedules. Project control personnel can never really know what everyone has to do on the different projects that they encounter. They are basically at the mercy of project personnel to provide them with information on what the project scope is. Some projects are similar in scope, but each has its own peculiarities that differentiate it from other projects. Most project personnel are happy to participate in the process of planning and scheduling their work. They recognize that this method insures them an opportunity to validate their operations and provide feedback regarding management directives.

However, some personnel are reluctant about participating in the project control process. Some genuinely do not understand what is being asked of them. The process can be completely alien to them. Participating in something they do not understand, and that has penalties for inadequate performance, can be a frightening proposition. They fear a loss of job will be the inevitable result of their participation. Others are secretive about their work: they fear a loss of power if they share information with the organization.

Whatever the case, it is necessary to establish what everyone has to do on the project. There are several approaches that can be utilized to accomplish this task. The most effective method I have found is to establish the scope of the first group. Next, I meet with other groups and allow them to review this information and utilize it as a template for their own efforts. This accomplishes the following:

1. Other groups now have the opportunity to review what their colleagues perceive as their project scope. This focuses their thoughts on what they will have to do. There may be conflict between project participants as they articulate what they believe has to be done and by whom. Yet, conflict can be healthy when it indicates that people care about the quality of the job performed.
2. Illustrating scope with project controls logic techniques generates questions regarding the meaning of the symbols. Defining and explaining the symbols that represent activities and constraints assist future participants in addressing their own tasks in a similar manner. It also provides them with the realization that information is often passed between organizations to accomplish work activities. This realization generates thoughts as to what type of information they will require from other organizations to accomplish their tasks. If their requirement for information is not included they will question the validity of the project logic. Questioning the scope of another organization allows issues

that may have been overlooked to surface. In addition, it puts everyone on notice that the project is a serious undertaking and nothing but the best is going to be tolerated by project personnel.

3. Finally, people who tend to be secretive about their activities are confronted by group peer pressure to contribute to the process. If they continue to maintain their reticence, it becomes obvious that management must confront them. Managers do not enjoy confronting such people. Yet, when it is obvious that everyone else is cooperating, action becomes mandatory. If this action does not occur, management then assumes responsibility for an incomplete project control system. Such a system will inevitably impact the "triple constraints" of a project and inhibit its chance of success (Osborne & Nakamura, 1994).

With the above in mind, a number of meetings were arranged to review Payson's plan/schedule with the law school library project group. Both Payson and the law school library reviewed the milestones and the plan/schedule logic and discussed the resources that would be used to accomplish the work. The law school library staff indicated that their logic was similar to Payson's. They also had the responsibility of supporting milestones for their own test, patron and production loads. Additionally, they identified the requirement to train their staff in using the new system.

Although the law school library was not budgeted to receive new computers, their offices were being remodeled. This remodeling effort was to reflect a reorganization that related to the new system installation. Additional logic and milestones were added to define staff training and remodeling. One librarian was assigned full time to this effort. Additionally, he was assisted part time by two other librarians.

Further discussion revealed that Payson did indeed have a key interface point with the law school library. The law school library required input on Payson's patrons to assemble and complete their system's patron load. This patron load provided the names and records of students and faculty who utilized the university's libraries. As both Payson and the law school library had different procedures for their respective patrons, their shared system database required comparison and adjustment to deal with common patrons. The law school library had assumed responsibility to complete this adjustment and was dependant on Payson for procedural and patron input to complete their effort. This dependency was important because the patron load was the last step of system input prior to completion of the system. Both libraries would have to cooperate with one another to accomplish this final step in the system's installation.

Phase 2: CPM Plan/Schedule

With this important final tie established between all of the organizations, I completed phase 2, the overall project CPM. Durations and resources for each activity had been established from management estimates as we developed the logic plan. Manual forward and backward passes were performed on the CPM, which provided total float for each activity and a project critical path. Dates were imposed on each activity that indicated the early and late start and finish requirements. Clough (1972) defines activity early start dates as the earliest time that the activity can possibly start allowing for the times required for preceding activities. The early finish dates is determined by adding the duration of the activity to the early start. This is known as the forward pass through the CPM network. The late finish date is the very latest that an activity can finish without impacting the overall project completion date. Late start dates are calculated by subtracting the duration of the activity from the late finish time. This is known as the backward pass. The difference, as mentioned earlier, between early dates and late dates is the total float for each activity. The idea of presenting early dates encouraged personnel to focus on starting and finishing their tasks as quickly as possible.

I completed a drawing with the above information that provided the organizations an illustration of their responsibilities (Appendix A). Each organization reviewed and approved the plan.

Phase 3: Monitoring the Plan/Schedule and Project Controls

The final step in the project controls process was to insure that everyone was working toward the approved plan. Projects are continuously adjusting to their environment and subtle changes in direction begin to occur immediately. Lock (1977) indicates that project managers cannot be gullible; they must be dynamic and assert control. Periodic meetings are the best way to insure that the project is continuously reflecting the project manager's philosophy and decisions. Since this project was approximately six months in duration, it was decided to have weekly meetings to status and revise the plan/schedule.

Rather than to continuously hand draw new logic and manually calculate float, I input the data into Microsoft Project software. This software package, when updated, generated the latest project picture. After each meeting, I would update the status of various work sites (Appendix B). Any questions regarding what was critical, or what had to be done, could be reviewed in a timely fashion. This method insured that everyone had the latest picture of the project. It was very important that project documents be current, so that personnel realized that the agreed upon plan/schedule was actually being followed.

Over the next six months, weekly meetings provided the opportunity for continuous refinement of the plan/schedule. As activities neared their start dates, they were broken down into more detailed steps. This allowed participants the opportunity to precisely define what they were going to do after thorough research. The law school library took advantage of this: they detailed the steps necessary to train their staff on each new system module and subcontracted the remodeling of their offices. Their initial 17 activities increased to approximately 43 by the time the project was completed.

Early on through the weekly discussions, we established the objectives for completing the project by specific dates. Payson required the new system to be operable by commencement of the first session of summer school and the law school library required completion by commencement of the fall semester. With this final input, the project had finish dates that all of its participants recognized as necessary to achieve. Also, these final milestones increased the durations of the project for both Payson and the law school library. Payson had an additional eight days to complete their system and new computer installation, while the law school library had approximately two more months for their system installation, training and remodeling.

Identifying these completion milestone dates is important to a project. When it not established when and why a project must terminate, project personnel lose the impetus to complete their activities as scheduled. As Sanchez indicates, projects are for specific periods of time with definite organizational objectives (1996). It is important that project personnel understand that the project has a time limit and the reason for that limit. With this knowledge project personnel will recognize that their best performance is necessary to insure timely completion to support specific organizational objectives.

At this early point in the process, I was now comfortable that all the requirements necessary to activate a project control system had been implemented. The plan/schedule reflected the input of all the participants. It displayed milestones, logic, interfaces and completion commitments. Resources had been allocated to insure successful culminations of tasks and communication channels between all of the participants were in place. The above was completed within the first month of the project.

During the six months of the project, I presented schedule drawings that depicted only the early start and finish dates and total float for project activities. Management alone controlled the float for each activity. Based on their knowledge of project resources and requirements, they determined if float could be allowed for later dates. This philosophy insured management maintained control of the project and eliminated confusion among project personnel regarding two sets of dates (early and late).

As the project progressed, the organizations encountered different challenges. Payson Central University Library, as mentioned earlier, was the first library to install the system. They encountered incomplete duplication of records during the initial separation of the database between themselves and the Law School Library. Additionally, their periodicals were missing holdings, the call number prioritization, which prioritized periodical searches, was incorrect and call numbers for indexing local thesis fields were also incorrect (C. Thomas, personal communication, September 5, 2000). These problems required them to reject acceptance of the test load until Endeavor satisfactorily resolved them. I added additional activities to reflect this situation and determined that the project had sufficient float to absorb these challenges.

Endeavor corrected the problems and the test load was accepted. Payson closely monitored its activities and milestones. Its management focused on staff completing their activities on or before schedule, allowing them to identify problems early. Early identification gave Payson time to solve them, without resorting to questionable last minute heroics, such as heavy overtime work. This is a major benefit of project controls. Payson recognized this benefit, and correctly chose to utilize this strategy to insure that its staff completed their milestones as required.

The law school library also experienced system-related problems during the test and production loads. They receive serials in all kinds of patterns that created irregularities with the Voyager system (P. Bohl, personal communication, April 6, 2000). Both Endeavor and the library staffs worked together to solve this problem. Eventually, it was necessary for the law school library staff to manually transfer their serial holdings into the system to correct the problem.

Although Endeavor was not obligated contractually to use the schedule, it provided them with a clear picture of the consequences of not solving problems in a timely fashion. The schedule indicated that the system needed to be operable by commencement of the summer semester for Payson, and by the fall semester for the law school library. If Endeavor failed to meet these requirements, their reputation in the academic community would suffer. They might not be remembered as having a system that had problems with law serials, but they certainly would be remembered as a company that negatively impacted an academic library and its patrons.

The law school library recognized another benefit of project controls to respond to challenges. They often had several activities occurring at the same time, which, due to their limited resources, could not always be accomplished as early as scheduled. The most prominent example concerned the remodeling of their offices. This effort entailed developing a floor plan, procuring office furniture and coordinating the removal of old furniture with installation of new furniture. Although the work commenced on schedule, several false starts impacted the effort. Initial contact with vendors revealed that their prices were exceeding the budget and that their products did not conform to university specifications.

When the schedule required that the law school library devote greater time to system installation, they did not have sufficient resources for both system installation and remodel. Although the physical move was not critical to the system installation, it was predicated on reorganizing the library staff along new system responsibilities. Personnel needed to be located in the same physical space as their organization to insure communication and supervision by library management. Consequently, management wanted both the system installed and the move complete by the fall semester.

Management correctly recognized this problem and focused its resources on system installation issues first. After prioritizing their options they reviewed the CPM and found that float was available for organizing the move. By carefully monitoring the float allowed for the move they were able to shift resources to solve the move issues between system issues. This resulted in both areas completing their work in a timely manner. Project controls float data provided law school library management appropriate information to solve this problem.

Without a project controls system the identification of problems and their correction is difficult. The CPM network provides a powerful graphical and mathematical model that assists in solving project resource problems. A project cannot hope to finish on time unless staff and resources are managed efficiently. The project network model allows management to investigate various resource options without actually expending them. These options can be as simple as reviewing float between activities for competing resources, known as "resource leveling", or as complex as "crashing" a series of critical path activities with extra resources to complete a project early (Clough & Sears, 1979, p. 188). The ability to accurately calculate and predict correct answers from a project model insures that management has the necessary facts and flexibility to make effective decisions.

Conclusion

This project began with a number of goals that the participants wished to accomplish during its duration. Pepperdine library administration indicated that its chief goal was the successful installation of the Voyager system. This goal was successfully completed by commencement of the summer semester for Payson and the fall semester for the law school library. New computer installation and office reconfigurations were also successfully completed during this period to support operations of both libraries.

Both library directors indicated a desire for increased communication between library staffs and Endeavor. Open communication is the basic goal of any project controls system. It is designed to solicit constructive input from all participants to establish project scope. Once the scope is verified and approved, the system maintains its visibility and allows participants periodically update project status. Comments by library staff indicated that communication was successfully established and maintained. Many indicated that the project controls system was most helpful to them by establishing what had to be done and when it had to be done. These comments and the successful accomplishment of the project indicate that the project control system also satisfied the communication goals of the library directors.

My goals for the project were basically the same as those defined by Pepperdine's library management. Additionally, I was interested in observing the impact of the project control system on the library staff. Specifically, how would project controls aid the staff in dealing with the "triple constraints" of time, cost and project performance specifications (Osborne & Nakamura, 1994)?

Both libraries used the system in different but equally effective ways, to control the project time constraint. As Payson was the first library scheduled for installation of the system, management recognized the probability that they would be the first to encounter system installation challenges. Consequently, project personnel started and completed their work as scheduled by early dates and conserved their project total float.

When acceptance of the test load became a challenge requiring more time by Endeavor, Payson had the necessary float available for them to solve the problem. This approach allowed Endeavor the time to provide them with a quality product and allowed the project to be completed on schedule.

The law school library also recognized that project total float could aid them in managing their limited resources. They used float to shift their resources between project activities based on how critical they were to the overall project duration. With float available for their office reconfiguration move, they postponed working on these activities until resources and budget issues were resolved and available. Instead they concentrated on completing critical system installation activities during this period. When system activities were no longer critical, they shifted resources back to the office move activities and successfully met their critical completion dates.

This is known as resource leveling. It is a powerful tool that allows management to optimize its resources while meeting schedule commitments. The principle is simple. Scarce resources are shifted between activities based upon how much float the activity has. Those activities with smaller amounts of float are designated as critical for project completion. They receive priority resources to work early scheduled dates. Activities with larger amounts of float are postponed until resources are available. They are worked to late schedule dates. Sophisticated utilization of this tool insures that the project resources are expended as efficiently as possible. This tool guarantees that the hiring of additional personnel for short spans of time, or requiring overtime, is undertaken only if current resources cannot be efficiently shifted between activities with float. Such analysis eliminates project cost overruns that result from such practices.

The experiences of both libraries provided them valuable insight on project controls time management tools. They learned how both float management and resource leveling provides the insight necessary to accomplish work within time constraints using allowable resources. This exposure can be extremely positive in understanding and managing the time and resource constraints of future projects.

Judging the success of the cost constraint for this project was more difficult. Costs for the project were not tracked due to funds already having been committed by Pepperdine for installation of the new system. However, an as-built man-hour histogram was submitted to the university that revealed that approximately 1900 staff hours were required to install the system (Appendix C). This histogram illustrates how staff resources were expended during the length of the project.

Management from both libraries exhibited an interest in the approximate cost for installing the new system. With a resource distribution histogram of hours, it is a simple matter to multiply staff cost per hour to produce a curve that indicates accumulated personnel costs spread over the duration of the project. This type of information can be helpful when considering similar future projects. Such projects may have to extend over several budget periods due to funding constraints. Possessing and reviewing this historical cost data would provide guidance to the library administration in staggering their costs to accommodate incremental projects.

Once an institution's management becomes experienced and sophisticated in working with project cost models their desire to use them will increase. Understanding how your resources are going to be consumed is a simple calculation with a resource distribution histogram. The picture is indeed worth a thousand words. Administrators use such models to simulate several scenarios to consider. The result is a more efficient operation of the project due to refined planning.

Cost data is an important part of any project and deserves serious consideration. Economic conditions are capricious and library budgets are inexorably tied to them. Administrators who present a budget committee with a well-defined project scope tied to a resource distribution histogram demonstrate thoughtful and informed planning. With this concrete data the budget committee can not only talk numbers, but also understand what work must be accomplished within a given timeframe to create the product. Rather than seeking a blanket endorsement, the project administrator, through project control models gives all parties the opportunity to assist in planning and funding it. This type of partnering offers a better chance for budget approval.

Additionally, the project has a greater chance for success because not only has management planned the effort, but staff has also had the opportunity to contribute. Their contribution provides them the opportunity to study the project and decide how they can best support and accomplish its goals. They, rather than management, will be doing the actual work and their input represents a realistic view of what is required. Staff participation in planning, in turn, creates staff commitment to the project plan and a responsibility to fulfill its goals.

By correctly defining the project's performance specifications, project controls provide all parties with a picture of the consequences of not installing a working system on time. This knowledge stimulates solutions, rather than finger pointing. The successful resolution of the serials problem at Pepperdine with no impact on overall project completion was an example of this aspect of project controls. Even though Endeavor had not committed to project controls in the contract, the visibility of actions and outcomes provided incentive for Endeavor to work with the libraries in finding the solution. The result was a problem that was resolved without impacting the overall completion of the project.

In conclusion, the success achieved by Pepperdine's library staff in utilizing project controls indicates that the system is a viable planning tool that libraries can satisfactorily use to control their time, cost and project performance specifications. As the Chinese philosopher Sun Tzu stated in his The Art of War, "Planning is that by which harm is avoided and advantage gained" (1971, p. 152). Adoption of a project controls system insures that a project has the optimum tools available for the critical task of avoiding harm and gaining advantage.

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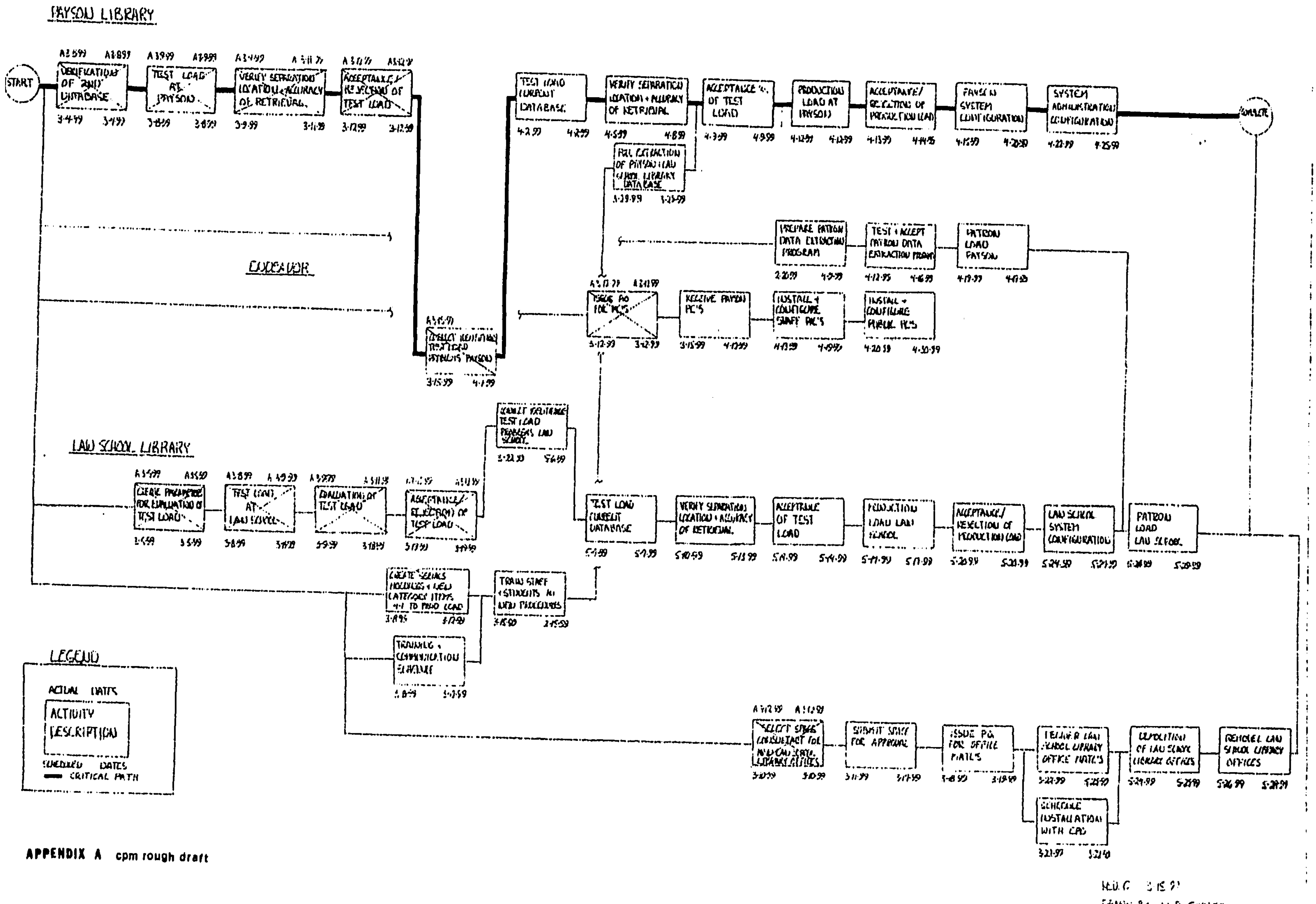
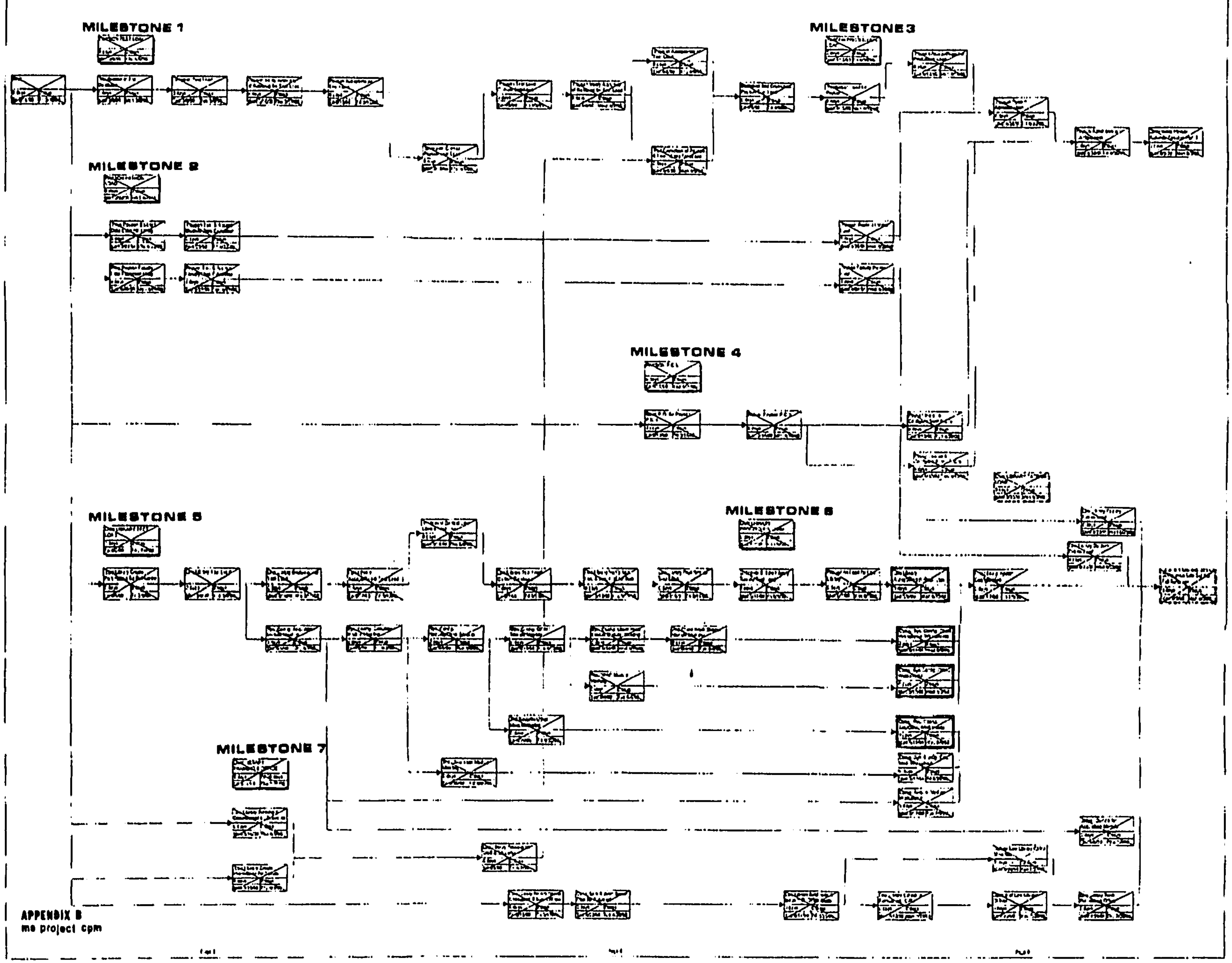


APPENDIX A cpm rough draft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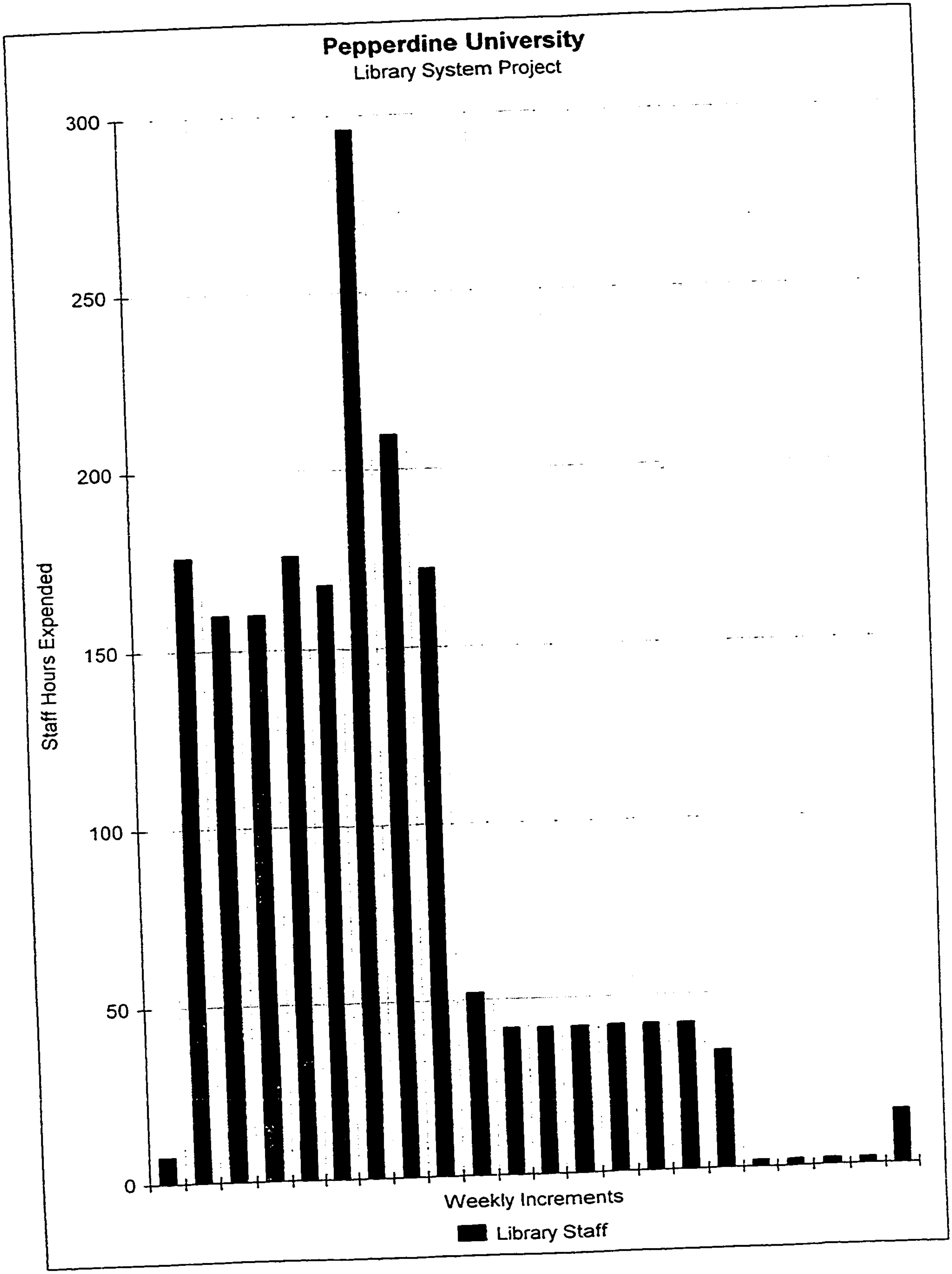
APPENDIX B
ms project cpm



Pepperdine University
Library System Project
300
250
200
150
100
50
0
Staff Hours Expended
Weekly Increments
Library Staff

APPENDIX C